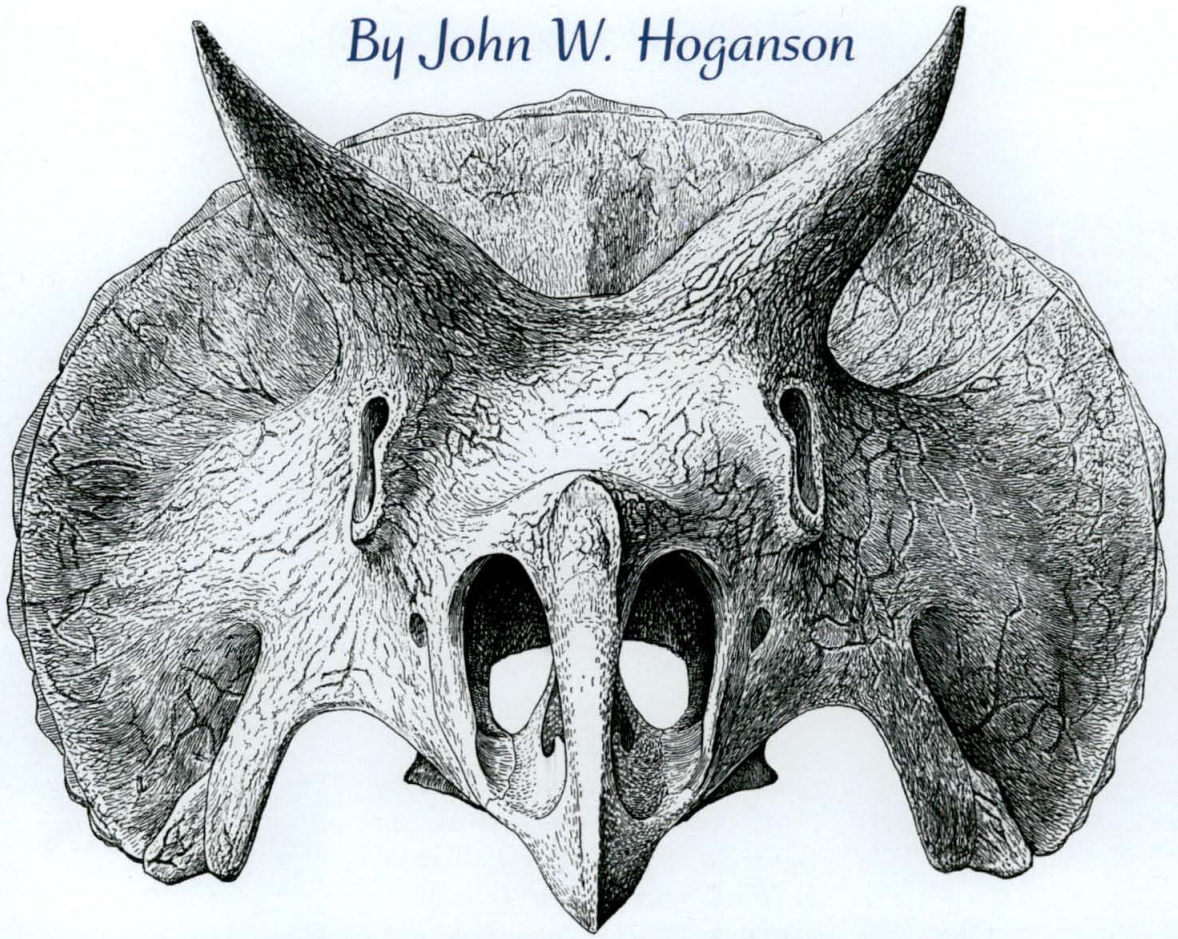
Dinosaurs, Sharks, and Woolly Mammoths: Glimpses of Life in North Dakota's Prehistoric Past

By John W. Hoganson



Drawing of *Triceratops* dinosaur skull, from "The Ceratopsia," by John B. Hatcher, U.S. Geological Survey Monograph 49 (1907)

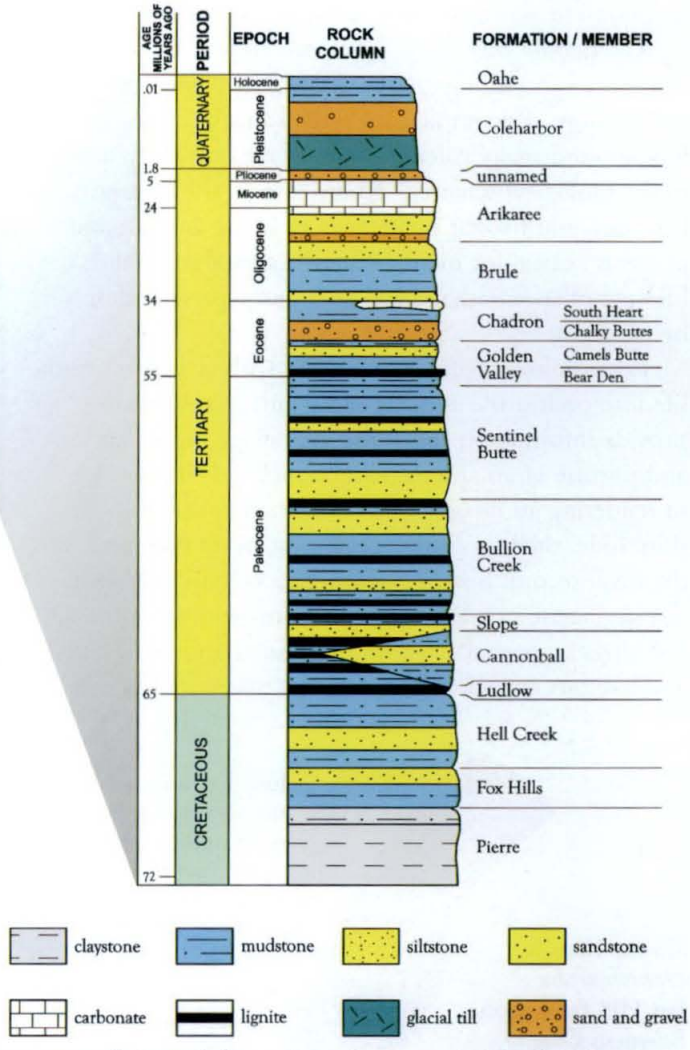
Picture yourself eighty million years ago, swimming in a warm-water ocean with sharks, forty-foot-long sea lizards, giant sea turtles, and fifteen-foot squids where Cooperstown, Walhalla, and McCanna are today; or beachcombing along a delta shoreline near present-day Bismarck sixty-eight million years ago, with dinosaurs such as Triceratops, Tyrannosaurus rex, *and dromaeosaurs lurking in a forest at water's edge; or, sixty million years ago, canoeing through a swamp inhabited by bald cypresses, magnolias, palm trees, fifteen-foot crocodiles, and primate-like mammals in the area of today's Medora, Watford City, and Williston. Thirty million years ago you might have gone on safari through an African-like savanna around modern-day Dickinson and Amidon, surrounded by rhinoceroses, camels, two-foot-tall horses, and saber-toothed cats; go back twelve thousand years, and you might have snowshoed across a tundra plain near today's Fort Yates, Fargo, Minot and Grand Forks, warily watching for woolly mammoths and giant ground sloths. These glimpses of life in North Dakota at different times in our geologic past are based on the state's fossil record. They are explored in the exhibits of the North Dakota Heritage Center, where most of the fossils in this issue are on display, and in the pages of this issue.*

The history of life in North Dakota from the time that monstrous sea creatures inhabited the primordial oceans millions of years ago to the appearance of humans only a few thousand years ago is a fascinating saga. That history is being deciphered by paleontologists through the study of fossils, our primary means of documenting the evolutionary history of past life. Fossils define the kinds of plants and animals that inhabited North Dakota at various times in the geologic past. They also are important indicators of how the region's climates and environments have changed through time.

The most difficult concept for the general public—or, for that matter, students of paleontology—to comprehend is the great span of geologic time, sometimes referred to as "deep time." Earth is considered to be about 4.6 billion years old, and the beginnings of life on Earth are believed to date back about 3.6 billion years. These numbers are small, however, compared to the tens of billions of years cosmologists and astronomers consider in studying events in the universe. It is difficult for humans to conceive of anything that is, say, even a million years old because human experiences are measured in hours, days, months, and years.

Like historical events, paleontological events have little meaning unless they are put into a time perspective. Beginning about 1820, a calendar called the Geologic Time Scale was developed—and is still being refined—that divides the Earth's history into segments of time (eras, periods, epochs) which are most often based on changes in life forms. So, for example, the major time divisions—the Paleozoic, Mesozoic, and Cenozoic Eras—literally mean "ancient life" (Paleozoic), "middle life" (Mesozoic), and "recent life" (Cenozoic). The numerical dates of these time divisions, usually expressed in millions of years, are based on measurements of the radioactive decay of minerals found in rock formations. This is called radiometric dating. The geologic calendar is frequently expressed through the use of a stratigraphic column.

AGE (MILLIONS OF YEARS AGO)	ERA	PERIOD	FORMATION or GROUP
	CENOZOIC	QUATERNARY	OAHE COLEHARBOR
		TERTIARY	ARIKAREE WHITE RIVER GOLDEN VALLEY SENTINEL BUTTE BULLION CREEK SLOPE CANNONBALL LUDLOW
65	MESOZOIC	CRETACEOUS	HELL CREEK FOX HILLS PIERRE
			NIOBRARA CARLILE GREENHORN BELLE FOURCHE
			MOWRY NEWCASTLE SKULL CREEK INYAN KARA
		JURASSIC	SWIFT RIERDON PIPER
		TRIASSIC	SPEARFISH MINNEKAHTA
250	PALEOZOIC	PERMIAN	OPECHE
		PENNSYLVANIAN	BROOM CREEK AMSDEN TYLER
		MISSISSIPPIAN	BIG SNOWY MADISON
		DEVONIAN	BAKKEN THREE FORKS BIRDBEAR DUPEROW SOURIS RIVER DAWSON BAY PRAIRIE
		SILURIAN	WINNIPEGOSIS INTERLAKE
		ORDOVICIAN	STONEWALL STONY MOUNTAIN RED RIVER
			ROUGHLOCK ICEBOX BLACK ISLAND
570		CAMBRIAN	DEADWOOD
4500		PRECAMBRIAN	



The North Dakota stratigraphic column lists the names of the rock formations that occur in North Dakota and the types of rocks of which they are composed. This list of formations is arranged on the Geologic Time Scale from oldest to youngest in "stratigraphic" order. The geologic time period and age in millions of years for each formation is thereby indicated. For example, the Pierre Formation consists mostly of claystone and was deposited during the Cretaceous Period over seventy million years ago. The Niobrara Formation is older and lies stratigraphically beneath the Pierre Formation, while the Fox Hills Formation is younger and stratigraphically above the Pierre Formation.

Fossils and Fossil Hunters

Fossils, from the Latin *fossilis,* meaning "digging" or "dug up," are remains of plants and animals preserved in the earth. Fossils can be the actual remains, such as shell or bone, or can be traces, such as tracks or burrows. This definition is not as straightforward as it seems because some paleontologists require the remains to be prehistoric—that is, at least around five thousand years old—to be considered fossils, while others include remains from historic times. Objects constructed by humans (pottery, projectile points, buildings, etc.) are termed artifacts, not fossils, and are studied by archaeologists, not paleontologists.

Fossils are not common because when a plant or animal dies most often the remains simply rot away or are scavenged, leaving no trace that it ever existed. This is particularly true for "soft-bodied" animals—creatures such as worms and most insects that do not have a shell or internal skeleton; the remains of these creatures, and most others, must be buried quickly for them to have a chance of becoming fossilized. Also, many forces, particularly weathering, can destroy fossils before they are found. Sadly, our record of life on Earth is very incomplete. It has been estimated that only one percent of all species that ever lived have left a fossil record.[1] It is especially rare to find a complete fossilized skelton of an animal because factors like scavenging and weathering can affect the carcass before it is buried. As the scientist Susan Kidwell once put it, "Life after death is risky." Because of the scarcity of complete or mostly complete skeletons, paleontologists fantasize about finding them. For these reasons, fossils should be viewed as objects of great scientific value. They are an important part of our natural heritage and should be preserved whenever possible for all humankind.

The people who study fossils are known as paleontologists. Paleontology is generally considered a subdiscipline of geology, but it is an interdisciplinary science that blends geology and biology. Paleontologists have extensive training in biology, and many paleontologists have university degrees in the biological sciences. Knowledge of the anatomy, behavior, and habitat preferences of living animals and plants is critical for interpreting the appearances and lifeways of species that are extinct and represented only by fossils.

Paleontologists often collaborate with artists to breathe life into prehistoric animals and plants. Fossils can provide information about the size, shape, musculature, and posture of an animal, all of which aids the artist in rendering an image of the animal. The color of the skin, hide, shell, or feathers is almost never preserved in the fossil record, however, allowing a certain amount of artistic license in creating the final image of the animal. Paintings by several artists of prehistoric animals, plants, and habitats appear throughout this issue.

Photo by John Hoganson

Triceratops **dinosaur dig west of Marmarth, Slope County, in 2002. A partial skeleton of a *Triceratops* was excavated; rib bones can be seen in the lower right of this picture, and the skull is pictured on page 18. This was a public fossil dig co-sponsored by the North Dakota Geological Survey and USDA Forest Service-Dakota Prairie Grasslands.**

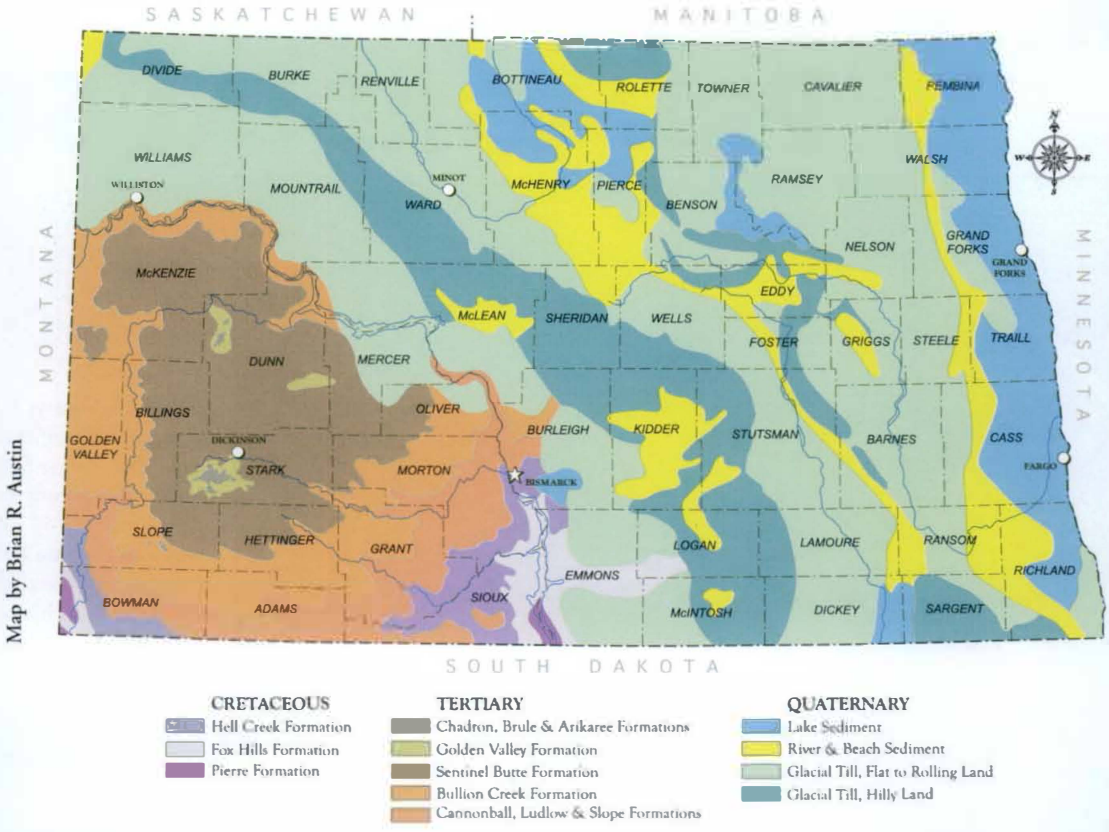
Shrimp burrow
Ophiomorpha
Fox Hill Formation
Bowman County
Length 200 mm
ND 94-134.2

Fossils include not only actual remains like bones, but also traces, such as this burrow (left) in which a shrimp lived about sixty-eight million years ago. Fossils range in size from the massive bones of dinosaurs such as *Edmontosaurus* to remains barely visible to the eye, such as the minute fossil teeth of some sharks. Because shark skeletons are made of cartilage, which does not preserve, these shark teeth are the only clues to one of the most important groups of animals that lived in the ancient oceans of North Dakota. Paleontologists disaggregate the rock in which the teeth are embedded in order to recover these tiny remains.

Shark tooth
Squalus minor
Cannonball Formation
Bowman County
Width 3.4 mm
UND 15823

Actual Size
(3.4 mm)

Geologic Map of North Dakota



Geologists also name the rock formations that were deposited during each geologic time period. The names are based on the geologic location where the best example of the rocks can be seen. Formations are defined by the characteristics of the rocks, such as composition (sandstone, siltstone, mudstone, for example), color, thickness, the kinds of fossils they contain, and many other attributes. The areas where a particular formation appears on the surface can be mapped and plotted on a geologic map. Paleontologists can use these geologic maps to guide them to places where rocks containing particular kinds of fossils may be found. For example, the North Dakota geologic map above shows areas where the rocks known as the Hell Creek Formation surface. (The name of this formation comes from Hell Creek in northeastern Montana, where extensive exposures of the rocks are found.) The stratigraphic column of North Dakota identifies the Hell Creek Formation as having been laid down between sixty-seven and sixty-five million years ago—at the very end of the age of dinosaurs. Paleontologists would therefore expect those areas to have the potential for yielding dinosaur fossils. Knowledge of the location, lithology (rock type), age, and kinds of fossils found in the formations presented on the Geologic Map and Stratigraphic Column of North Dakota has been accumulating since the 1800s, based on research conducted by geologists and paleontologists from North Dakota and many other places. These tools, coupled with reports of past studies, many of which are cited in this issue, provide a basis for the many paleontological investigations that are currently underway in the state. The following glimpses of life in North Dakota's prehistoric past provide a summary of this knowledge accumulated over many decades. The reader should be advised that this knowledge is continually being refined through frequent discovery of fossils of plants and animals that were previously not known to exist in North Dakota. With this in mind, let us take a journey through time beginning about five hundred million years ago, when North Dakota was covered by primordial seas.

> *Fossil hunting is by far the most fascinating of all sports. . . . It has some danger, enough to give it zest . . . and the danger is wholly to the hunter. It has uncertainty and excitement and all the thrills of gambling with none of its vicious features. The hunter never knows what his bag may be, perhaps nothing, perhaps a creature never before seen by human eyes. Over the next hill may lie a great discovery! It requires knowledge, skill, and some degree of hardihood. . . . The fossil hunter does not kill, he resurrects. And the result of this sport is to add to the sum of human pleasure and to the treasure of human knowledge."*[2]
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> *George Gaylord Simpson,* Attending Marvels, *1934.*

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